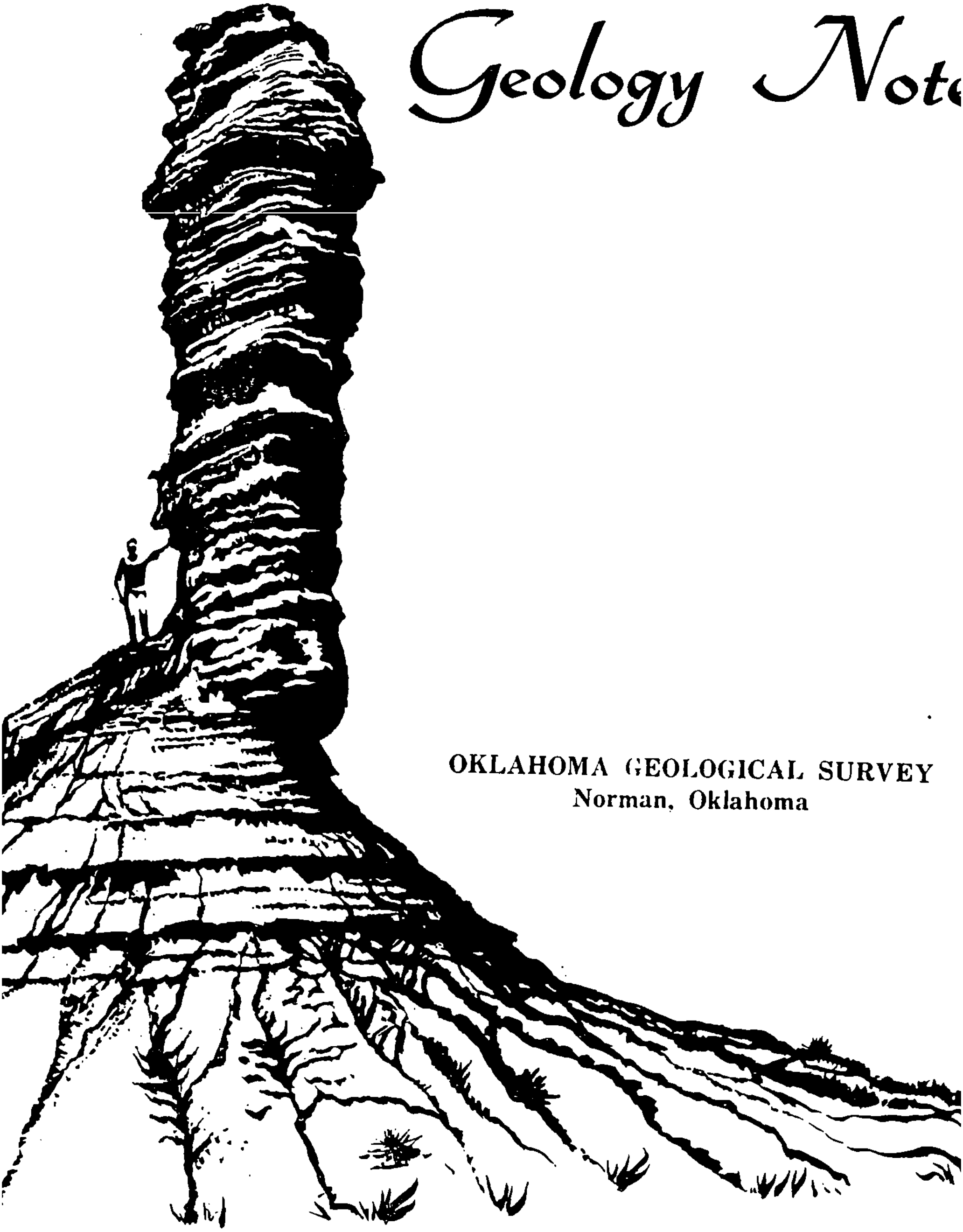
OKLAHOMA

Geology Notes



OKLAHOMA GEOLOGICAL SURVEY
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Arkoma Basin Symposium

The Seventh Biennial Geological Symposium, sponsored by the School of Geology, The University of Oklahoma; the Arkansas Geological and Conservation Commission; and the Department of Business and Industrial Services, Extension Division, The University of Oklahoma, will be held on March 7-8, 1961. The symposium, under the chairmanship of Dr. Carl A. Moore, will be dedicated to the memory of C. W. Tomlinson, and its theme will be *The Arkoma Basin.*

The two-day symposium will consist of four technical sessions at which the following thirteen papers will be presented and discussed.

Tectonics of the Ouachita Mountains of Arkansas and Oklahoma, by Clifford B. Branan, petroleum geologist, Oklahoma City, Okla.

Evidence and distribution of normal faulting in the east-central portion of the Arkoma basin, by John P. Shields, consultant geologist, Fort Smith, Ark.

Pre-Des Moines correlations from Arbuckle Mountains to western Arkansas. S. E. Frezon, U. S. Geological Survey, Denver, Colo.

A subsurface correlation of the gas producing formations of northwestern Arkansas. by Andrew B. Bacho. Jr., Gulf Oil Corp., Fort Smith. Ark.

The Viola limestone of the Oklahoma portion of Arkoma basin. by Tom Mairs, graduate student, The University of Oklahoma

The Hunton group of the Oklahoma portion of Arkoma basin, by Richard England, graduate student, The University of Oklahoma.

Regional geology of the pre-Des Moines Pennsylvanian of Arkansas, by E. E. Glick, U. S. Geological Survey, Denver, Colo.

Regional geology of the post-Atoka Pennsylvanian of Arkansas, by B. R. Haley, U. S. Geological Survey, Denver. Colo.

A comparison of Plio-Miocene sedimentation of the Gulf Coast with the Atoka sedimentation of the Arkoma basin. by B. J. Scull, Sun Oil Co., Richardson. Texas

Pennsylvanian system of McAlester basin and of the Mid-Continent platform. by Carl C. Branson, School of Geology, The University of Oklahoma

Palynological evidence of low-grade metamorphism in the Arkoma basin. by L. R. Wilson, professor of geology, The University of Oklahoma

Application of logging techniques in the Arkansas Valley. by Roger N. Planalp. Athletic Mining and Smelting Co.. Fort Smith. Ark.

Some drilling programs and problems in the Arkoma basin. by Gene A. Bowman. Big Chief Drilling Co., Oklahoma City. Okla.

A dinner will be given on the evening of the 7th. the speaker being William J. Geary. Peak Petroleum Co.. Denver, Colo., whose topic will be *Modern techniques applied to fractured shale production.*

The registration fee of $10.00 will cover admission to the sessions and the cost of the published proceedings which will be made available at a later date. Non-registrants may obtain the proceedings from the Extension Division. The University of Oklahoma. at a price to be determined by the cost of printing.

Annotated Bibliography and Index of Oklahoma Geology 1960

Prepared by Neville M. Curtis, Jr.

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INDEX

Arkoma Basin Field Trip

The Tulsa Geological Society and the Fort Smith Geological Society will sonsor a joint field trip through the Arkoma basin on April 14-15, 1961. The first day of the trip, under the guidance of James C. Perryman and Roger N. Planalp, Fort Smith Geological Society, will be spent surveying the area west of Fort Smith as far as Wilburton and Quinton and studying several large anticlines that are currently of interest. The group will return to Fort Smith in the evening.

The trip, on the second day, under the direction of H. H. Hall, Tulsa Geological Society, will cover some anticlines south of Fort Smith and will extend as far south as Kiamichi Mountain. Return to Fort Smith will be via Heavener, Howe, and Hartford.

A guidebook, including road logs and pertinent articles, will be prepared.

New Theses Added to O. U. Geology Library

The following Master of Science theses were added to The University of Oklahoma Geology Library during the month of January, 1961:

Stratigraphic relations of the Sycamore limestone (Mississippian) in southwestern Oklahoma, by Chesley Key Culp, Jr.

Areal geology of the Moyers quadrangle, Pushmataha County, Oklahoma, by Harry W. Todd.

Stratigraphy and sedimentation of the Pennsylvanian-Permian Fountain formation, Fremont County, Colorado, by Tom Hillary Warren.

One doctoral dissertation, *Stratigraphy and paleontology of the Elvins formation, southeast Missouri*, by Vincent Ellsworth Kurtz, was also added to the library.

Salt Springs in Oklahoma

Porter E. Ward*

The salt springs in western Oklahoma are of local importance because they are unusual, and of regional importance to water supply because they contaminate surface- and ground-water supplies downstream from their sources. Figure 1 shows the location of the major salt springs in western Oklahoma. Brine flowing from the springs saturates the valley alluvium and evaporation from the alluvial surface produces a thin crust of salt that is dissolved during rainstorms but reforms soon after the rain stops.

Before the coming of the white man, Indians collected salt at the springs and used it as an article of trade. When the pioneers began moving west many of them stopped at the salt springs to collect salt. Initially, the pioneers collected only enough salt for their personal needs by scraping up the salt crust that formed around the springs (fig. 2). Soon after settlers began moving into the region attempts were made to process the salt commercially. Jesse Chisholm, of Chisholm Trail fame, produced salt at the Blaine County Salt Plain before the Civil War. A few such attempts were moderately successful for short periods, and today salt is produced on a small scale at two spring sites in Oklahoma. One of these is on the Big Salt Plain of the Cimarron River near Edith in Woods County (fig. 3) and the other is in Salton Gulch on Elm Fork

*U. S. Geological Survey, Norman, Oklahoma.

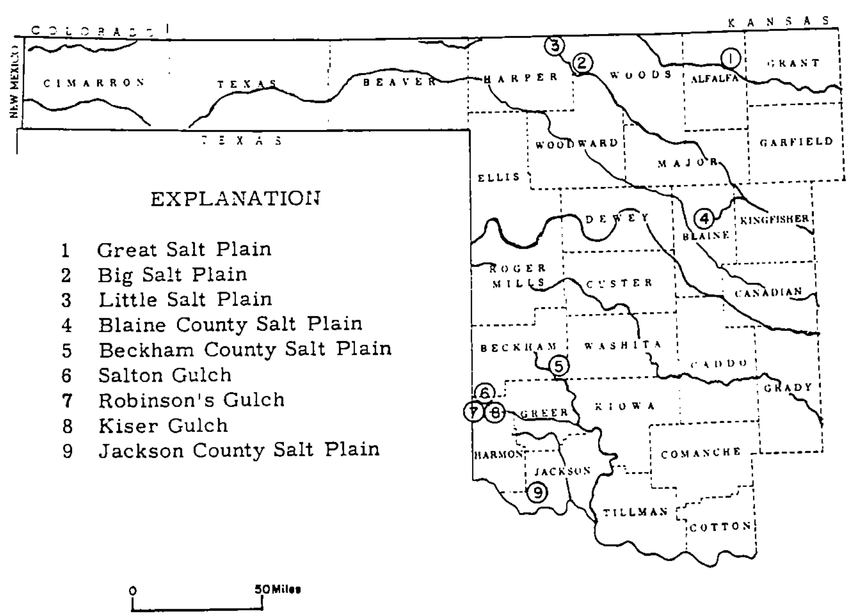


Figure 1. *Map of western Oklahoma showing the location of major salt-spring areas.*

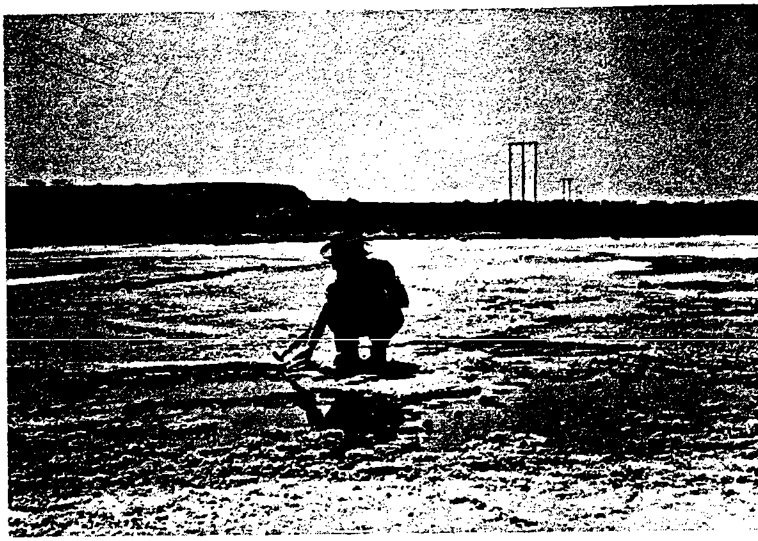


FIGURE 2. *Salt crust surrounding springs on the Beckham County Salt Plain, 3 miles south of Carter.*

Red River in Harmon County (fig. 4). At both localities salty spring water is collected in ponds where solar evaporation of the water causes the salt to concentrate and precipitate (fig. 4). After a layer of salt several inches thick forms on the bottom of the ponds it is scraped out and dried. The salt is then ready for market without further treatment.

Recently much attention has been focused on the salt springs, not because of the economic value of the salt but because of the adverse effect of the salt springs upon the water supply of Oklahoma. The U. S. Public Health Service, assisted by the U. S. Geological Survey, is conducting a special study of pollution caused by the salt springs in the Arkansas and Red River Basins, including the springs in western Oklahoma. The objectives of the Public Health Service project are to locate the natural salt sources, to determine the importance and type of pollutants entering the Arkansas and Red Rivers, and to devise practical means of containing or controlling them. The efforts of the U. S. Geological Survey are directed toward the determination of the source and occurrence, geologic conditions, and hydrology of natural saline pollution in these river basins.

The major saline springs in Oklahoma are in the western part of the State in the outcrop area of rocks of Permian age. The spring water is of the sodium chloride type, and the chloride concentrations range from about 20,000 ppm (parts per million) to 200,000 ppm. The springs in the nine areas shown on figure 1 bring sodium chloride salt to the surface at a total rate estimated to be more than 6,000 tons per day (table I).

Studies in progress indicate that the salt in the spring water is derived from beds of subsurface salt in the Permian redbeds. Recent

TABLE I.—APPROXIMATE FLOW AND TOTAL SALT CONTRIBUTED BY NINE SALT SPRING AREAS IN WESTERN OKLAHOMA

Map No.	*Name*	*Approximate flow (cfs)*	*Salt (NaCl) contributed (tons per day)*
1	Great Salt Plain	...	3,000
2	Big Salt Plain	3.4	2,500
3	Little Salt Plain	0.2	150
4	Blaine Co. Salt Plain	5.4	150
5	Beckham Co. Salt Plain	...	few
6	Salton Gulch	0.3	500 (6–8)
7	Robinson's Gulch	0.3	
8	Kiser Gulch	0.2	
9	Jackson Co. Salt Plain	...	few
	Total		6,300

drilling has shown that at places the salt beds are less than 100 feet below the surface. Where the salt is shallow and geologic conditions are favorable, water will circulate beneath the ground to the salt-bearing beds and dissolve large quantities of the salt. The salty ground water then emerges through salt springs.

FIGURE 3. *Big Salt Plain of the Cimarron River, near Edith, between Woods and Woodward Counties.*

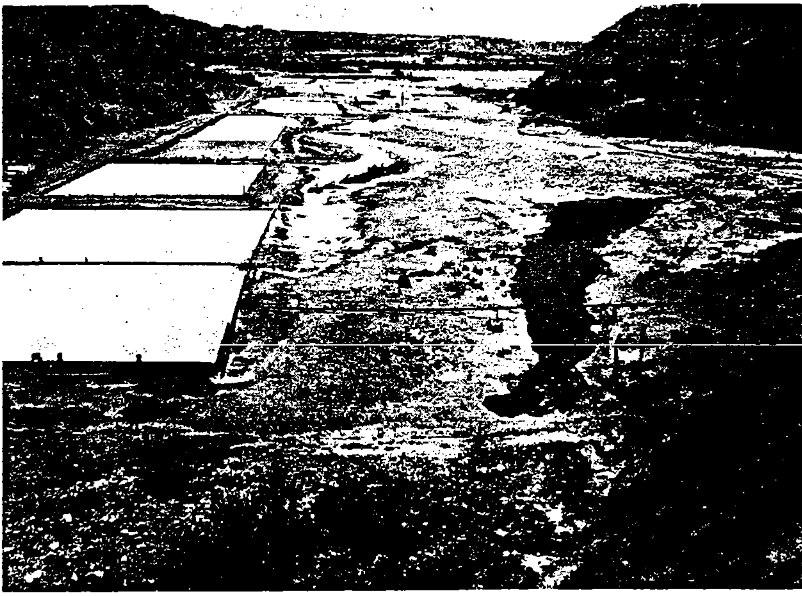


FIGURE 4. *Brine ponds in the Salton Gulch, northern Harmon County.*

Paleogeologic Maps

The use of various types of paleogeologic maps for interpretation of sedimentary history and of patterns of potential oil-bearing rock bodies is discussed and illustrated in a new book. Dr. A. I. Levorsen of Tulsa has written a book which is needed in each geologist's library. Paleogeologic maps are defined as maps of the overlapped strata at a surface of unconformity as these strata were at the time of overlap. Subcrop maps in some instances are paleogeologic maps, in most instances are not in whole or in part.

The book is excellently illustrated by black-and-white maps and cross sections used to explain the types of maps employed and to show the development of structures and of sedimentary columns in many areas. Oklahoma geologists will find many illustrations from the State: Thomas oil field, Apache oil field, West Edmond oil field, Fox field, Oklahoma City region, and northeastern Oklahoma. Oklahoma also enters into several more general maps.

Dr. Levorsen uses paleogeologic maps to show the unlikelihood of continental drift. Paleogeologic maps of the world are an interesting innovation. The distinction between basins of deposition and structural basins is pointed out and most basins are said to be of structural origin.

The book is "Paleogeologic Maps," 1960, W. H. Freeman and Company, San Francisco and London. 174 pages, $6.00.

—C. C. B.

Polydeltoideus A NEW SILURIAN BLASTOID FROM OKLAHOMA

IRVING G. REIMANN* AND ROBERT O. FAY

A new blastoid genus, *Polydeltoideus*, from the Silurian Henryhouse shale of Oklahoma, is provisionally placed in the family Phaenoschismatidae. Although similar to *Pleuroschisma* Reimann in most details, it differs significantly in having two paradeltoid plates (new term) in conjunction with the hypodeltoid, and in having a steeply conical shape in side view.

The writers are indebted to Drs. G. Arthur Cooper and A. R. Loeblich, Jr., for the loan of material from the U. S. National Museum, to Mr. Harrell L. Strimple, who donated the type specimens, and to Dr. H. A. Lowenstam, who furnished other specimens.

Systematic Descriptions

Family PHAENOSCHISMATIDAE (*recte*) Etheridge and Carpenter 1886

POLYDELTOIDEUS new genus

Type species.—*Polydeltoideus enodatus*, new species.

Description.—Theca an attenuate cone with slightly concave sides. Summit broad, gently convex. Greatest width across the radial shoulders near top of the theca. Base narrow, attenuate. Cicatrix of stem small. Basals more than half the length of the theca, narrow below, slightly wider above for about a third of their height, and then widening more rapidly above to about three times the width at the stem. Lower part of base strongly depressed and flat along the interbasal sutures, the depression diminishing adorally. Radials comprising remainder of the height of the theca; shallowly notched for reception of the ambulacra;

*Director, The Exhibit Museum, University of Michigan

EXPLANATION OF PLATE I

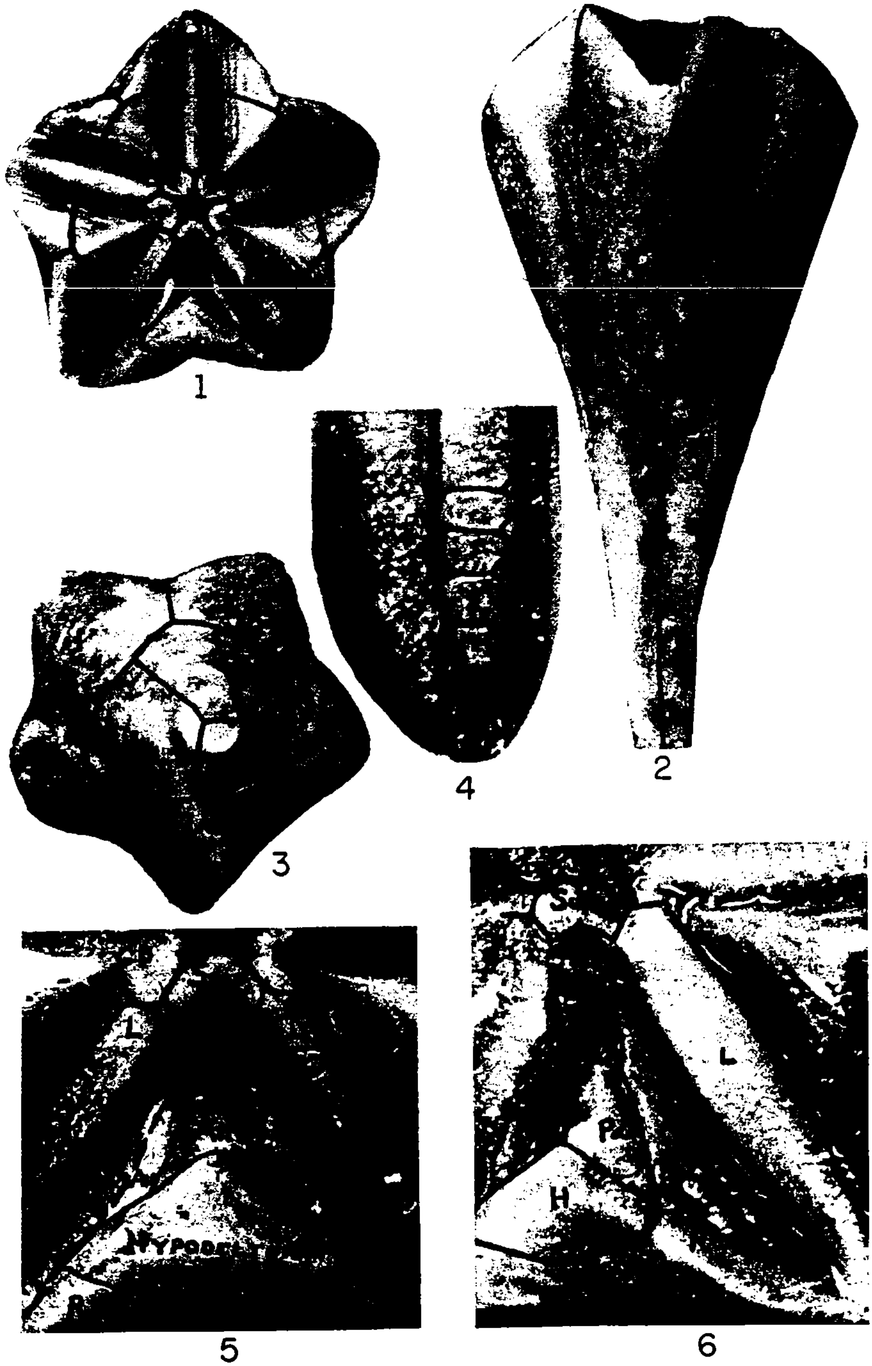
Polydeltoideus enodatus *n. sp., from Henryhouse shale, Oklahoma. The figured types are on deposit in the Museum of Paleontology, University of Michigan.*
(Photographs by R. O. Fay)

An—anal opening	*L—lancet*
Au—anal deltoid plate, unnamed	*Pa—paradeltoid*
D—deltoid	*R—radial*
H—hypodeltoid	*Sup—superdeltoid*

FIGURES 1-3, 5. *Holotype, No. 37.805, oral, ambulacral (D), aboral views (all x4.6), and anal view x12.0, respectively.*

FIGURES 4, 6. *Paratype, No. 37.806, (B) ambulacral tip showing outer side plates (x25.0), and anal view from (C) ambulacral side, showing a paradeltoid in place (x17.0).*

PLATE I



somewhat spade-shaped, wider above, convex in the upper part with greatest convexity toward the summit.

Radial tips bent slightly inward. Interradial areas rather flat along the lower part of the interradial sutures, depressed along the upper part.

Deltoids confined to the summit, except in the posterior interradius, elevated and angular along the deltoid crest; crest lowest adorally, in some specimens sloping inward. Lip elevated, with a shallow groove separating it from the main body of the plate; laterally and a little aborally notched for reception of the adoral end of the lancet plate.

The posterior region around the anal opening is composed of at least six plates, a superdeltoid, hypodeltoid, two large unnamed anal deltoid plates, and two paradeltoids (new term). The superdeltoid is exposed adorally, bordered posteriorly by the anus, and is rounded hexagonal. The two large unnamed deltoid plates, on either side of the anal opening, rest upon the aboral face of the superdeltoid, are each notched by three to four or more hydrospire slits, and are each overlapped aborally by the adjacent radial limbs, and in part by the lateral corners of the hypodeltoid. The hydrospire slits extend across the adjacent radial limbs, nearly at right angles to the sutures. The hypodeltoid is thick, broadly hexagonal, abutting against the truncated radial limbs, and resting upon the aboral upper edges of the unnamed deltoid plates; strongly bevelled adorally, giving the body of the plate a wide diamond shape. There are two small *paradeltoid* plates (new term), called *accessory plates* by Reimann (1948), one on each side of the midline of the anal area, each resting upon the outer edge of the aboral part of each unnamed deltoid plate, and abutting aborally against the hypodeltoid. The anal opening is bordered adorally by the superdeltoid, laterally by the unnamed deltoid plates, and aborally by the paradeltoids. The oral opening is stellate, surrounded by the upturned tips of the deltoids. Deltoid tips not elevated above side plates, but at the same level as their surfaces; tips strongly elevated above ambulacral areas where side plates are missing.

Ambulacra lanceolate-subpetaloid, composed of broad side plates completely covering the stout and elevated lancet plates. Outer side plates subtriangular along ambulacral margins. Ten groups of hydrospires: those on the anal side slightly reduced in number. Hydrospire slits increasing in number with age; ten (the maximum observed) on either side of each ambulacrum (except on anal side) in the largest specimen. Some of the lowermost slits covered by the side plates; the remainder, about half, exposed.

Remarks.—In *Polydeltoideus* the adoral edges of the paradeltoids are bevelled as though other small plates may have adjoined them, although such small plates have not been observed on any of the specimens studied. With the exception of the superdeltoid and unnamed deltoid plates, the deltoid complex is loosely articulated, and the hypodeltoid and paradeltoids have been lost from many specimens. Other small movable plates, perhaps functioning together as a valve, may have been attached to the unnamed deltoid plates but were not preserved because of their weak articulation.

The name is compounded from Greek *polys*, many; and *deltoid*, for deltoid plates, which is from Greek *delta* plus *eidos*, form.

POLYDELTOIDEUS ENODATUS n. sp.
Plate I, figures 1-6

Description.—General characters of the genus. The deltoid crests are acute, meeting the upper ends of the radial tips at an angle of 10 degrees, measured with mouth as center, as seen from the side of the calyx. Hydrospire slits extending nearly to extreme tips of the radials. The holotype is 21 mm long by 11 mm wide.

Types.—Holotype, No. 37,805; paratypes, No. 37,806 (one specimen) and No. 37,807 (one polished section), donated by Mr. Harrell L. Strimple to Museum of Paleontology, University of Michigan. All from the Henryhouse shale, SE¼ SE¼ SE¼ NE¼ sec. 5, T. 2 N., R. 6 E., east side of road, Pontotoc County, Oklahoma.

Four specimens, as yet unnumbered, are on deposit in the collection of the Oklahoma Geological Survey. They are from Chimneyhill Creek, NW¼ NW¼ sec. 33, T. 3 N., R. 6 E., collected by W. E. Ham; from SW¼ NW¼ sec. 33, T. 2 N., R. 6 E., collected by A. Graffham; from glade east edge of road, NW¼ NW¼ sec. 33, T. 3 N., R. 6 E., collected by P. K. Sutherland and T. W. Amsden; and from NW¼ SW¼ sec. 4, T. 2 N., R. 6 E., All are from the Henryhouse shale of Pontotoc County, Oklahoma.

Other specimens, one of which shows both paradeltoids in place, are on deposit at the U. S. National Museum.

The trivial name of this species is from Latin *enodatus*, from *enodatio*, development.

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———— 1948, New genus of blastoids from the Silurian: Geol. Soc. America, Bull., vol. 59, no. 12, pt. 2, p. 1346 (abstract).

Permophorus CHAVAN, 1954, A NEW NAME FOR *Pleurophorus* KING, 1848

ROBERT O. FAY

The name *Permophorus* was proposed by Chavan in 1954 to replace the homonym *Pleurophorus* King, 1848, not *Pleurophorus* Mulsant, 1842, in an obscure reference. The present note is written in order to bring this name change to the attention of workers on Permian rocks and fossils. Thanks are due Dr. Ellis Yochelson of the U. S. National Museum and to Dr. David Nicol of Southern Illinois University for information which led to the finding of the reference. The paper is:

Chavan, Andreé, 1954, Les *Pleurophorus* et genres voisins: Cahiers géologiques de Thiory, no. 22, p. 200, January, 1954.

THE TYPE OF *Tricoelocrinus* MEEK AND WORTHEN

ROBERT O. FAY

The type specimen of *Tricoelocrinus woodmani* (Meek and Worthen) 1868, the type species for the genus *Tricoelocrinus*, is on deposit at the American Museum of Natural History, catalog number 7225/1. The label reads "Geol. Ill., pl. 16, figs. 4a-d. Keokuk ls. ?, Salem. Ind., purchase." Meek and Worthen (1868, p. 356) stated, "The specific name of this form is given in honor of Mr. H. T. Woodman, of Dubuque, Iowa, to whom we are indebted for the use of the only specimen we have seen." In 1873 the same authors figured the type specimen and used the same description as that of the original article. The American Museum trustees purchased the H. T. Woodman collection in 1881. The specimen is silicified, weathered, and cracked, as shown in plate I and text-figure 1.

Tricoelocrinus Meek and Worthen 1868 (emend.)

Calyx subconical or subpyramidal in ventral half, subspherical in dorsal half, truncated at summit; maximum width below midheight; basals 3, hexagonal, indented along basiradial sutures, with two ridges (A-B) on azygous basal and three ridges (B-C-D and D-E-A) on each of the other two basals; radials 5, elongate, overlapping bevelled edges of deltoids, with narrow, elongate radial sinus; deltoids 4, short, confined to summit, each with a paired spiracle; anal side with epideltoid similar to the other four deltoids with a paired spiracle, separate from anal opening, with hypodeltoid resting on bevelled edge of two unnamed plates and abutting against radial limbs: anal opening between epideltoid and hypodeltoid on adoral and aboral sides respectively, with two unnamed plates on either side; unnamed plates overlapped by radial limbs on anal side; oral opening surrounded by 5 deltoid lips and 5 lancet stipes between each deltoid lip; ambulacra narrow, linear, with about 28 side plates in 10 mm; secondary side plates broadly triangular, resting on abmedial-adoral corner of adjacent primary side plate, with small brachiolar pit on admedial portion leading to side food groove: main food groove with approximately 4 cover-plate sockets per side plate; pores between outer margins of secondary side plate, adjacent aboral portion of the next adoral primary side plate, and adjacent radial wall; hydrospires presumed to be 3 on each side of an ambulacrum, thick. Range, Mississippian, North America.

Type species: *Pentremites (Troostocrinus) woodmani* Meek and Worthen, 1868, later figured by Meek and Worthen in 1873.

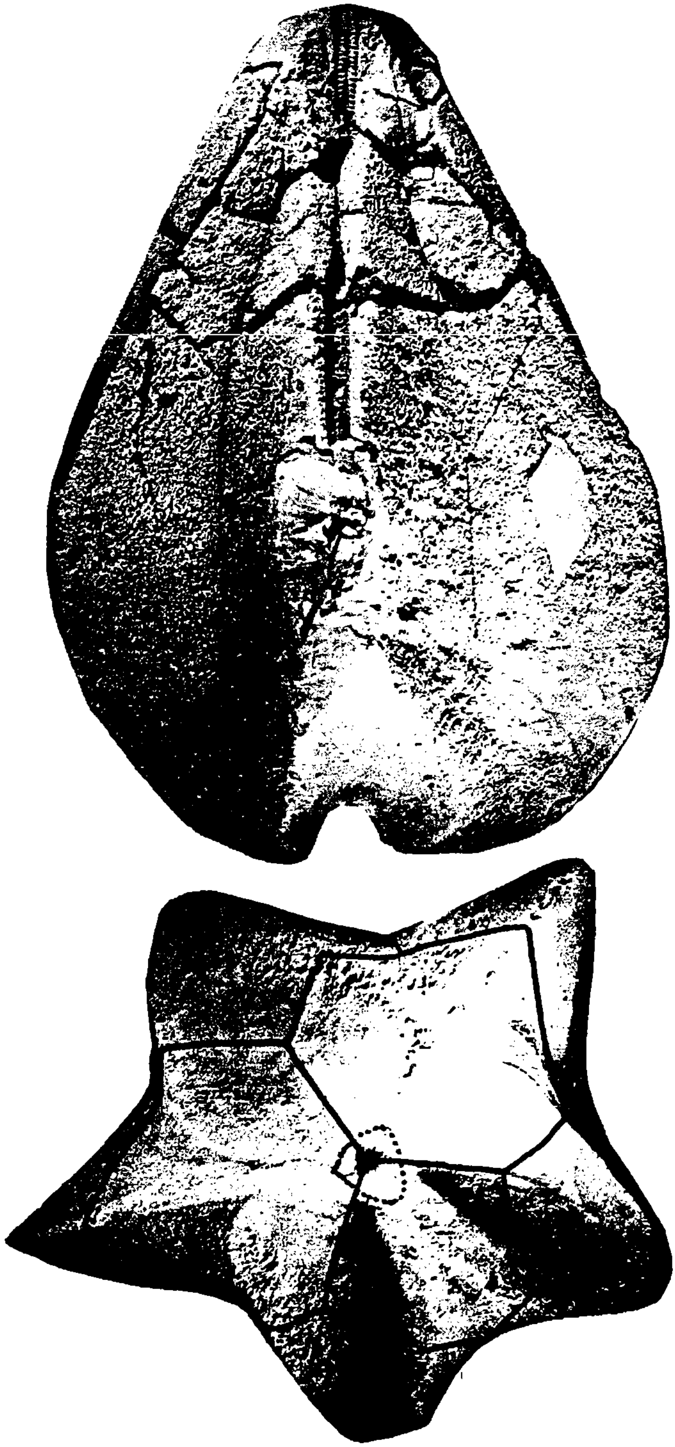
EXPLANATION OF PLATE I

Tricoelocrinus woodmani *(Meek and Worthen), the type specimen*

Above: *Side view showing anterior ambulacrum, x1.9.*

Below: *Aboral view, with anterior ambulacrum toward bottom of page and B ambulacrum to right, with suture patterns drawn in ink, x2.2.*

PLATE I

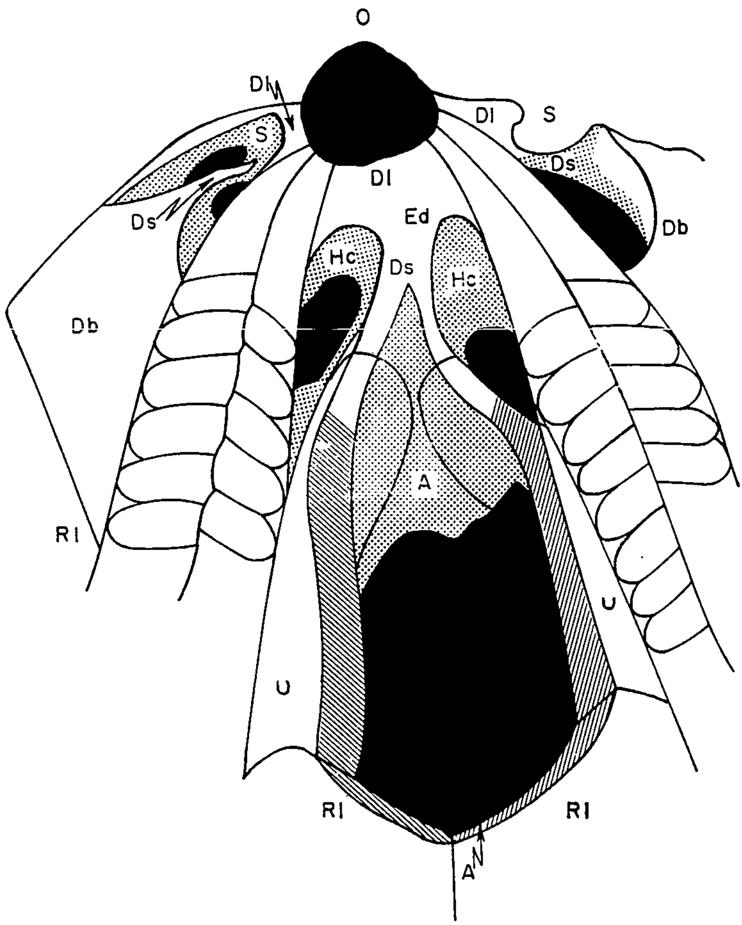


TEXT-FIGURE 1. Tricoelocrinus woodmani *(Meek and Worthen), anal area of type specimen, x14.*

Tricoelocrinus woodmani (Meek and Worthen) 1868

Plate I, text-figures 1-3

Characters same as that of genus. The epideltoid is pierced at its lateral aboral extremities by two hydrospire canals, one on either side of the thin median deltoid septum. These canals converge into a notch in the outer surface of the deltoid septum, giving the appearance of one spiracle with elongate aboral extremities along the ambulacral margins. This type of opening is termed a *paired spiracle;* it is one opening in which the deltoid septum is thin and exposed externally for a short distance, thus exposing the hydrospire canals, giving the appearance of two separate spiracles in weathered specimens. The type specimen is weathered and thus shows 10 openings that are partly convergent

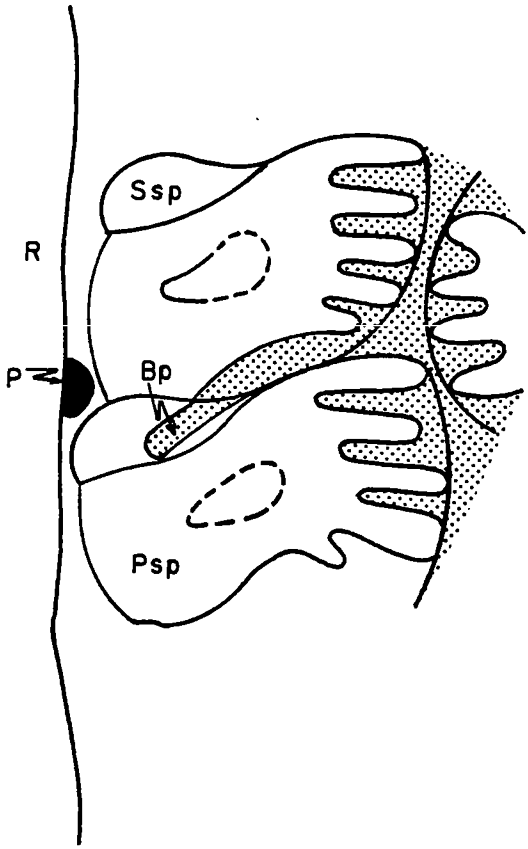


TEXT-FIGURE 2. Tricoelocrinus woodmani, *diagram of view shown in text-figure 1.*

A—anal opening	*Hc—hydrospire canal*
Db—deltoid body	*O—oral opening*
Dl—deltoid lip	*Rl—radial limb**
Ds—deltoid septum	*S—spiracle*
Ed—epideltoid	*U—unnamed plate*

**Cross-hatch shading indicates hypodeltoid sutures.*

into the normal 5 paired spiracles. The hypodeltoid is large, roughly pentagonal (missing in the type specimen, but with definite suture pattern preserved showing its outline), resting laterally on two unnamed plates which are overlapped by adjacent radial limbs, presumably not in contact with the epideltoid, with the anal opening between the hypodeltoid, unnamed plates, and the epideltoid. The unnamed plates on the anal



TEXT-FIGURE 3. *Detail of part of left posterior (D) ambulacrum, oral opening toward top, x110. Illinois Department of Geology, 2102 Warsaw beds, Salem, Indiana*

Bp—brachiolar pit *Psp—primary side plate*
P—pore *Ssp—secondary side plate*
R—radial

side bend along the sides of the hypodeltoid and in back of the hypodeltoid internally, resting on top of the bevelled edge of the epideltoid. Thus the epideltoid is homologous in shape and function to the other four deltoids in the other interradial areas. The paired spiracle on the anal side is separate from the anal opening, the deltoid septum bifurcating aborally to meet the adjacent infolded walls of the unnamed plates. The lancet plate is completely covered by the side plates. The description of the side plates and associated structures was taken from observations of another specimen (Illinois Dept. Geol., 2102, Warsaw beds, Salem, Indiana). The type specimen loaned to Meek and Worthen came from the Keokuk limestone?, Salem. Indiana. Thus it appears that the range of this species is Keokuk? to Warsaw, or upper Osagean to lower Meramecian series of the Mississippian system.

UNDERGROUND LPG STORAGE IN OKLAHOMA

LOUISE JORDAN

The capacity of underground storage caverns for LPG in the United States has increased from less than 10 million barrels to more than 60 million barrels in the seven-year period, 1954-1960 (Bizal, 1960, p. 85). The seventh annual survey of the *Oil and Gas Journal* reports that capacity to store LPG in underground formations in the United States will reach 60,785,000 barrels when projects now underway or planned are completed. The greater part of the storage capacity, 50,595,850 barrels, or 83 percent, is in salt domes and salt layers. Mined caverns in shale, limestone, or granite have a capacity for 6,464,800 barrels; sandstones, which have contained oil, gas, or water, account for 3,725,000 barrels.

In Oklahoma, capacity for storage will reach 633,000 barrels when the Continental Oil Company completes its mined limestone cavern near Ponca City in April 1961. Table I is a summary of the LPG underground storage facilities in Oklahoma.

TABLE I—UNDERGROUND PROPANE STORAGE FACILITIES IN OKLAHOMA

Year completed	*Company, county* *Type of storage* *Formation, age*	*Storage capacity (bbls)*
1940	Humble Oil & Refg. Co., Pontotoc Abandoned oil wells Hunton limestone (Silurian)	175,000
1953	Shell Oil Co., Beckham Salt layer Blaine formation (Permian)	15,000
1955	Sinclair Oil & Gas Co., Seminole Mined shale Nellie Bly formation (Late Pennsylvanian)	110.000
1960	Texaco Inc. et al., Beaver Salt layer Flowerpot formation (Permian)	33.000
1961	Continental Oil Co., Kay Mined limestone (Early Permian)	300.000

The geology of the storage facilities in Beckham, Seminole, and Beaver Counties has been described by Jordan (1959a, 1959b, 1961.) The Kay County facility will be described when the cavern is completed.

The earliest underground storage was in an abandoned oil well in the Fitts Field of Pontotoc County. The Carter Oil Company, now a division of the Humble Oil & Refining Company, started storing butane in November 1940 in well "A" in the Fitts Field when liquid products from their natural-gosoline plant were produced in excess of demand.

The well had been completed to produce oil from the lower oolitic member of the Chimneyhill formation (Hunton group, Silurian) in March 1937. At that time, the initial production of the well was 96 barrels of 38.4° gravity oil and 350,000 cubic feet of gas in the first eight hours.

In March 1952, a second well, "B", was converted to a storage well. It had originally been completed to produce from Hunton limestone in October 1936, and had tested 532 barrels of oil in the first 2.5 hours with an estimated 5,000,000 cubic feet in 24 hours. Total production figures for the two wells are not known because oil production for the entire lease, including that from Ordovician sandstones, was comingled.

During the period from November 1940 to November 1960, both butane and propane were injected and withdrawn from storage, butane being stored in the earlier years and propane in the later years (date of change not available). Table II gives the statistics on injection and withdrawal for each well obtained from Humble Oil & Refining Company.

TABLE II—LPG INJECTIONS AND WITHDRAWALS, PONTOTOC COUNTY, OKLAHOMA, 1940-1960

	Injected (gals)	*Withdrawn (gals)*
"A" well		
Butane	6,336,750	3,289.504
Propane	4,202,375	1,630,700
"B" well		
Butane	375.903	191.984
Propane	3,115,150	1,408.091

In June 1960, the "A" well was converted to a water disposal well. From the above data it must be concluded that the withdrawal efficiency of this reservoir was low because less than 50 percent of the injected liquid was recovered.

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